

Claims

1. A water desalination installation for the desalination of seawater according to the reverse osmosis method, comprising at least one membrane module (1) that is connected with a raw water feed line (2), via which raw water is supplied by means of a high-pressure pump (3); a permeate line (5), via which the desalinated water is discharged; as well as a concentrate line (6), via which concentrated salt water is discharged, characterized by an energy recovery unit (8) comprising a motor-driven pressure booster pump (9) arranged in the raw water feed line (2) either before the high-pressure pump (3) or between the high-pressure pump (3) and the membrane module (1); and a first turbine (11) arranged in the concentrate line (6) and mechanically coupled with the pressure booster pump (9).

2. The water desalination installation according to claim 1, characterized in that the high-pressure pump (3) is a multi-stage, first centrifugal pump driven at a constant number of revolutions by a first three-phase motor (4).

3. The water desalination installation according to claim 1 or 2, characterized in that the pressure booster pump (9) is driven by a second three-phase motor (12), the number of revolutions of which can be controlled by means of a variable frequency drive (13).

4. The water desalination installation according to claims 2 and 3, characterized in that the first three-phase motor (4) has an output ranging from a few hundred kW's to a few KW's, whereas the second three-phase motor (12) has a lower output than the first three-phase motor (4), ranging from a few kW's to a few hundred kW's.

5. The water desalination installation according to any one of claims 1 to 4, characterized in that the pressure booster pump (9) is a second centrifugal pump, whereby the second centrifugal pump and the first turbine (11) are arranged on a common drive shaft (10).

6. The water desalination installation according to any one of claims 1 to 5, characterized in that provision is made for a branch (14) in the concentrate line (6) between the membrane module (1) and the energy recovery unit (8), via which branch concentrated salt water can be supplied to

a second turbine (15), the latter being mechanically coupled with the high-pressure pump (3).

7. The water desalination installation according to claim 6, characterized in that provision is made between the branch (14) and the second turbine (15) for a throttling valve (16).

8. The water desalination installation according to any one of claims 1 to 7, characterized in that the first and/or the second turbine(s) are Pelton turbines.

9. The water desalination installation according to any one of claims 1 to 8, characterized in that the first and/or the second turbines are Francis turbines with adjustable guide vanes.

10. A water desalination installation for desalinating seawater according to the reverse osmosis method, comprising at least one membrane module (1) connected with a raw water feed line (2), via which raw water is supplied by means of a high-pressure pump (3); a permeate line (5), via which the desalinated water is discharged; and a concentrate line (6), via which concentrated salt water is

discharged, characterized by an energy recovery unit (8) comprising a pressure booster pump (9) arranged in the raw water feed line (2) either before the high-pressure pump (3) or between the high-pressure pump (3) and the membrane module (1); and a first turbine (11) arranged in the concentrate line (6) and mechanically coupled with the pressure booster pump (9); whereby provision is made in the concentrate line (6) between the membrane module (1) and the energy recovery unit (8) for a branch (14), via which concentrated salt water can be supplied to a second turbine (15) mechanically coupled with the high-pressure pump (3); and whereby provision is made between the branch (14) and the second turbine (15) for a throttling valve (16).

11. The water desalination installation according to claim 10, characterized in that the first and/or the second turbines are Pelton turbines.

12. A water desalination installation for the desalination of seawater according to the reverse osmosis method, comprising a first membrane module (18) connected with a raw water feed line (19), via which raw water is supplied by means of a high-pressure pump (20); a first

permeate line (21), via which desalinated water is discharged; a first concentrate line (22), via which concentrated salt water is discharged from the first membrane module (18); and a second membrane module (23), which is supplied with concentrated salt water by way of the first concentrate line (22), whereby the second membrane module (23) is connected with a second permeate line (24), via which desalinated water is discharged, and with a second concentrate line (25), via which concentrated salt water is discharged, characterized by a pressure booster pump (26) being arranged in the first concentrate line (22) between the first and the second membrane modules, and by a first turbine (28), said turbine being arranged in the second concentrate line (25) and mechanically coupled with the pressure booster pump (26); whereby provision is made in the second concentrate line (25) between the second membrane module (23) and the first turbine (28) for a branch (29), via which concentrated salt water can be supplied to a second turbine (31), the latter being mechanically coupled with the high-pressure pump (20); and whereby provision is made between the branch (29) and the second turbine (31) for a throttling valve (30).

13. The water desalination installation according to claim 12, characterized in that the first and/or the second turbines are Pelton turbines.

14. The water desalination installation according to any one of claims 12 and 13, characterized in that the pressure booster pump (26) is motor-driven.

15. The water desalination installation according to claim 14, characterized in that the pressure booster pump (26) is driven by a three-phase motor (33), the number of revolutions of which is controllable by means of a variable frequency drive (34).

16. A water desalination installation for the desalination of seawater according to the reverse osmosis method, comprising a first membrane module (35) that is connected with a raw water feed line (36), via which raw water is supplied by means of a high-pressure pump (38); a permeate line (39), via which the desalinated water is discharged; as well as a first concentrate line (40), via which concentrated salt water is discharged, characterized in that a turbine (41) arranged in the first concentrate line (40) is mechanically coupled with the high-pressure

pump (38), wherein concentrated salt water is supplied to the turbine (41) via at least one second concentrate line (42) from at least one second membrane module (43).

17. The water desalination installation according to claim 16, characterized in that the high-pressure pump (38) is driven by a three-phase motor (45), the number of revolutions of which can be controlled by means of a variable frequency drive (46).

18. The water desalination installation according to any one of claims 16 and 17, characterized in that the turbine (41) is a Pelton turbine.

19. Energy recovery unit for a water desalination installation operating according to the reverse osmosis method, comprising a pressure booster pump (9) and a Pelton turbine (11), whereas the pressure booster pump (9) and the Pelton turbine (11) are arranged on a common drive shaft (10).

20. Energy recovery unit according to claim 19, characterized by a three-phase motor (12) for driving the pressure booster pump (9), whereby the number of

revolutions of the three-phase motor (12) can be controlled by means of a variable frequency drive (13).